absorption will cover three hydrogen lines, and so on. Where you have lines, the lines never alter; where you have those base bands, or radicle bands, as they are called, they never alter; they are always in the same position, and never spread out or diminish either to the right or left. When you diminish the thickness of the fluid those bands are always present, and they are the last things to disappear in the absorption spectra.

Another remarkable thing with regard to these compounds is, as a rule there are two bands which are characteristic of their base. There is a band which is nearly always situated near the limit of the red, and another between wave-lengths 8000 to 11,000. That is to say, there is always a band to be seen somewhere about "*a*," and another somewhere about *ρ*. Those are characteristic of any particular compound we may have present.

You may say that I have been giving you a lecture on chemistry but in reality it is one which I hope may lead to results in solar physics. And I now venture to tell you how (Fig. 12). Here is a pair of bodies which we examined, to which I wish to draw your particular attention, namely, the spectra of aldehyde and par-aldehyde. Now aldehyde and par-aldehyde are the same bodies exactly in composition, only chemists tell us that par-aldehyde has three molecules of aldehyde in its one molecule—the only difference then between them is that there are three molecules of aldehyde combined to form par-aldehyde; aldehyde of course being one molecule by itself. Not only do chemists tell us that this is the case, but they know it, because if they heat par-aldehyde they get aldehyde formed again, and can reconvert this into par-aldehyde. Now I want you to notice the difference in the spectra between these two bodies. We have two bodies of the same chemical composition and of different molecular grouping, and you will see there is a total distinction in the two absorption spectra they yield. The only thing in common is the radical band. There may be one or two other coincidences, but all the rest of the spectra are perfectly distinct. Now if you refer back to Mr. Lockyer's lectures I think this alone will throw some light on what he has already said to you. He has told you, for instance, that the spectrum of iron in the flames and the spectrum of iron in the spots are dissimilar; and he has kindly furnished me with a photograph which shows one little part of the spectrum in which this is exemplified in a remarkable degree. In it we have three iron lines close to one another (Fig. 13). In the sun-spots two of those only appear, and in the flames the third alone appears

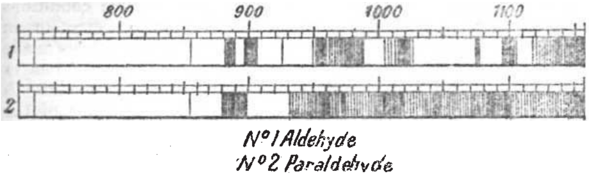

FIG. 12.—Absorption spectra of aldehyde and par-aldehyde.

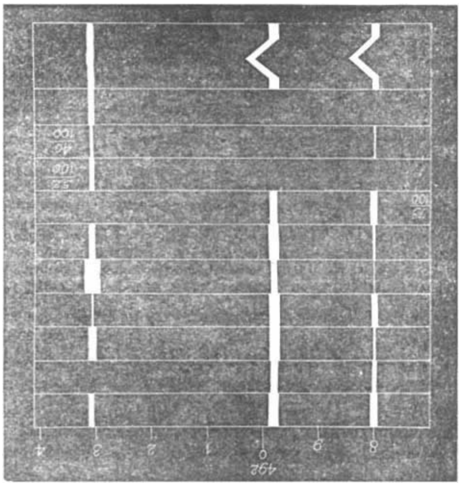

FIG. 13.—Diagram of three iron lines as observed by Lockyer.

If you look at this by the light of that photograph of aldehyde and par-aldehyde which I had on the screen, I think it is a reasonable deduction to make that the iron in the flame and that in the sun-spots have different molecular groupings. I say that this spectral analysis to which we have subjected aldehyde and par-aldehyde, and many other similarly constituted bodies, lends confirmation to that view. Of course, in the case of organic compounds, we can appeal to the chemist to analyse them for us, and he tells us that they are different molecular groupings. It is scarcely fair in one case to admit that the two spectra are given by two molecular groupings of the same substance, and in the other to deny it.

Again, we found that many lines were common to each hydrocarbon: thus we found a line at 867 of the scale, common to benzine and to alcohol; and to take one particular case, we found a special line common to water, hydrochloric acid, and chloroform. Has this any bearing on what you have heard? Mr. Lockyer has told you that some short lines are to be found in two, three, four, or even six different metals, not taking the long lines into account, as they might be considered to be due to impurities in the different spectra. Let us apply this to our case. A certain substance, A, has certain lines coincident with B; B also has certain lines coincident with C; and C also has other lines coincident with A. Now we will suppose these hydrocarbons were looked upon as elements, but that eventually the chemists split up what they considered elements, and found that the only substance which was common to the three was hydrogen. I leave you to draw the parallel between Mr. Lockyer's experiments and those which I have endeavoured, in a very rough and unsatisfactory manner, to bring before you. I think, if the chemist will admit that in the case of the hydrocarbons it is hydrogen which produces the lines common to all, there is no reason on earth, supposing the metals are not elements, why you should conceive that they should not have a common constituent in the same way that the organic compounds have a common constituent in the shape of hydrogen. I leave that for your consideration.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—Among the professorial notices of next term's lectures already published are those of the Professors of Astronomy, Geology, Botany, and Medicine.

Prof. Pritchard will give three courses at the University Observatory. He will lecture on the Lunar and planetary Theories, and will form two classes for practical instruction in the evenings. Prof. Prestwich will lecture on Stratigraphical Geology in the University Museum. Prof. Lawson will lecture on the Elements of Systematic Botany at the Botanic Garden.

The Professor of Medicine, Dr. Acland, gives notice that the next examination for a Radcliffe Travelling Fellowship will commence in the second week of February. Candidates are requested to communicate with the Professor.

The professors and lecturers engaged in teaching Physics have settled a combined system of lectures for next term as below:—

Hydromechanics, by Prof. Price; (1) Distribution of Terrestrial Magnetism, (2) Electricity developed by Contact of different Substances, by Prof. Clifton; Instruments and Methods employed in Optical Measurements, by Prof. Clifton; Practical Physics, by Prof. Clifton, Mr. Stocker, Mr. Heaton; The Generation and Measurement of Electric Currents, by Mr. Baynes; Electrostatics (treated Mathematically), by Mr. Hayes; Elementary Mechanics (treated Experimentally), by Mr. Stocker; Problems in Elementary Mechanics and Physics, by Mr. Heaton; Elementary Physics treated Experimentally (Heat and Light), by Mr. Dixon. The lectures on Optical Instruments are intended to serve as an introduction to the practical work in the laboratory. The last three courses of lectures are intended to meet the requirements of candidates for the Preliminary Honour Examination.

An examination for a Fellowship in biological subjects will be held at University College in February, 1882, beginning on Wednesday, February 22, at 9 a.m. Candidates are desired to call on Mr. C. J. Faulkner with the usual testimonials and certificates on Tuesday, February 21, between 5 and 6 p.m. But intending candidates are desired to send in their names to him before February 1, 1882, with a list of the subjects which they offer for examination, and at the same time to mention any branch of biology to which they have turned special

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attention, or on which they may have written original articles. Copies of any such articles should also be sent in. The examination will comprise (A) Papers of Questions, and (B) Practical Work, in Zoology, Physiology, and Botany. Further and more detailed information may be obtained of Mr. Faulkner.

Cambridge.—Prof. Stuart has received the offer of an engine from Dr. Siemens for his class-rooms of mechanism. The extension of the workshops is to be proceeded with at once.

Practical anatomy will commence next term on January 20. Demonstrations on Heat, by Mr. Glazebrook, and Electricity and Magnetism (advanced), by Mr. Shaw, will be given next term in the Cavendish Laboratory.

Mr. Garnett will give elementary lectures on Heat in St. John's College, beginning February 2, adapted to the 1st M.B., the Special Examination in Mechanism and Applied Science, and the first part of the Natural Sciences Tripos.

Glasgow.—The Clark Fellowship in Natural Science (225*l.* per annum for three years) has just been awarded to Mr. John H. Fullarton, M.A., B.Sc.

SOCIETIES AND ACADEMIES

London

Chemical Society, December 15.—Prof. Roscoe, president in the chair.—The following papers were read:—On some higher oxides of manganese and their hydrates, by W. H. Veley.—On a new alkaloid from Cinchona bark, by D. Howard and J. Hodgkin. The authors have extracted from the bark of China Cupræa an alkaloid closely resembling quinine in its general properties. It differs in the solubility of its salts; and from the readiness with which the alkaloid crystallises from ether; they have named it homoquinine. In the discussion which followed this paper Mr. Cownley mentioned that he, in conjunction with Dr. Paul, had separated apparently the same alkaloid, and that the results would be published in the next number of the *Pharmaceutical Journal*.—Contributions to the chemistry of the rare earth metals, by B. Brauner. This paper gives an account of a most thorough investigation of some compounds of cerium and didymium, and the determination of the atomic weight of lanthanum. The author has prepared a tetrafluoride of cerium and a pentoxide of didymium; he places these metals in the eighth series (horizontal) of Mendeljeff's system, thus: Cæsium 133, barium 137, lanthanum 139, cerium 141·6, didymium 146·6.

Royal Horticultural Society, December 12.—Lilies attacked by larvæ of *Brachycerus*, sp.: Mr. Maclachlan exhibited larvæ received from Mr. G. F. Wilson of Weybridge, which eat into the centre of the bulbs of lilies.—Cocoanut attacked by larvæ of *Hylocœtus*, sp. The same gentleman also showed some remarkable larvæ with a curiously indurated joint below the head. The species, he observed, was remarkable in penetrating the soft wood of palms, as the European species attacks hard wood, such as firs. He had met with the latter in the Black Forest.—Proliferous fir cone: Dr. M. T. Masters exhibited a cone of *Abies Douglasii*, in which the bracts were foliaceous, but the seed-scale partially atrophied, as is usually the case in proliferous cones. He contrasted this with a proliferous state of *Sciadopitys verticillata* (see Veitch's "Manual of Coniferæ," Fig. 46), in which the seed-scale became foliaceous, the bract remaining normal. The importance of this latter specimen in relation to the nature of the so-called leaves of *Sciadopitys* and of the seed-scale of the Abietineæ was commented on.—Embryo-bud of oak; Mr. W. G. Smith exhibited a specimen about one and a half inches in diameter. It was removed from beneath the bark. Such are extremely common in beeches, in which they vary from the size of peas to that of one's fist.

Society of Telegraph Engineers and of Electricians, December 15.—Annual general meeting.—The following gentlemen were elected as the council of the Society for the ensuing year:—President, Lieut.-Col. C. E. Webber, R.E.; Vice-presidents:—Willoughby Smith, Prof. W. G. Adams, F.R.S., C. E. Spagnoletti, M. Inst., C.E., Prof. D. E. Hughes, F.R.S., Hon. Treasurer, E. Graves; Hon. Secretary, Lieut.-Col. Frank Bolton; Council: W. S. Andrews, William T. Ansell, Sir Charles Bright, M. Inst. C.E., C. B. Bright, the Earl of Crawford and Balcarres, F.R.S., H. G. Ericksen, H. C. Forde, M. Inst. C.E., Matthew Gray, John Fletcher Moulton, F.R.S., Alexander Siemens, Augustus Stroh, C. F. Varley, F.R.S.; Associate Members of Council: Capt. J. T. Bucknill, R.E., C. H. B. Palen, T. R. Crompton, M. Inst. C.E.

Edinburgh

Royal Society, December 5.—The Right Hon. Lord Moncreiff, president, in the chair.—After a few introductory remarks, the president proceeded to read the obituary notices of Dr. J. Hill Burton, Dr. Andrew Wood, Prof. Sanders, Dr. Handyside, and the Rev. Dr. Cumming.—A quaternion paper on Hamilton's symbolical cubic, by Dr. Gustav Plarr, was presented by Prof. Tait, who then made an interesting communication on the subject of Mirage. By means of a simple assumption as to the law of variation of density in a stratum of air near the earth's surface, a complete explanation could be given of the very curious erect, inverted, and again erect images which were observed by Vince towards the end of last century, and formed the subject of the Bakerian Lecture of 1799. The necessary geometric conditions fulfilled by contiguous rays so as to give either an erect or an inverted image are well known; but no attempt had been made to imagine a simple state of affairs which would give *both* images at once. If the refractive index of a portion of a medium is given by the equation $\mu^2 = a^2 + y^2$, where y is the distance of the portion considered from a given plane—the plane, namely, of minimum density, then it can be easily shown by Hamilton's general method that the path of any ray which is deflected without touching the plane of minimum density is a distorted inverted catenary, and is obviously symmetrical with respect to a vertical line through its vertex. Whatever the law of density, the upper of two such contiguous rays emanating from a given point must in general have its vertex either a little behind or a little in front of that of the lower ray. In the former case the rays *cross* before they return to the same level from which they started, and an inverted image is the consequence; in the latter case they do not cross, and the result is an erect image. Hence the mere inspection of the locus of vertices of all possible rays coming from a given point is enough to tell the kind of image seen by any given pencil of rays belonging to the system. Also all rays that pass between any two given points on the same level must have their vertices on the vertical line half way between these points. If then the locus of vertices is such that it can be cut in three distinct points by a vertical straight line, evidently three images will be possible, two direct and one inverted, precisely as seen by Vince. That under certain circumstances the locus is of this nature can easily be demonstrated. It is not essential that the alteration of refractive index should extend through a large stratum of air; indeed the supposition that it holds only through a limited stratum, and that below the air may be of practically uniform density, gives results much more in accordance with what has been observed in nature.

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